SANDIA NATIONAL LABORATORIES
Albuquerque, New Mexico 87185

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TITLE: **INSTRUMENTATION SYSTEM VERIFICATION DURING GAGE CONNECTION TO STAND ALONE DATA ACQUISITION SYSTEMS**

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SNL Approval: [signature] Date: 11/2/94

SNL Safety Approval: [signature] Date: 11-3-94

MOC Cognizant Department Manager Concurrence: [signature] Date: 11-15-94

MOC Manager of Industrial Safety: [signature] Date: 11-16-94

SNL QA Approval: [signature] Date: 11-15-94
for 10/26/94

PURPOSE: This document will detail the system verification and connection process for gages associated with the Hewlett Packard (HP) 75000 Data Acquisition System (DAS) and the Fluke Hydra Data Bucket.

RESPONSIBILITY: It is the responsibility of the person(s) performing this procedure to be familiar with this procedure and references. They are also responsible for assuring that fixtures and measurement devices used are certified or in calibration and working properly.

SAFETY: All work will be done in accordance with the WIPP Safety Manual and any applicable Safe Operating Procedures (SOP's). Other safety requirements may be specified in a Safe Work Permit. The following safety concerns will also apply:

I. Access to the underground will be in accordance with existing WIPP Site policies.

II. Ground control in the work area will be performed prior to the start of work.

REFERENCES: (latest revision)

I. Procedures:

- SNL WIPP Procedure 485, Operation of the Fluke Hydra Data Bucket Data Acquisition System, with and without a PC Interface

- Sandia National Laboratories ES&H Standard Operating Procedure SP472218

II. Miscellaneous:

- Gage List (NOS File) for applicable test/experiment
- Cable Spreadsheets for applicable test/experiment
- Measurand Definition File (MDF) for applicable test/experiment
- HP 75000 Operating Manual
- Fluke Hydra 2635A Data Bucket Service Manual
- Fluke Hydra Logger Package Application Software Manual
- Copies of the gage calibration records and coefficient sheets (latest revision)

FORMS: (latest revision)

I. SNL Form SSSPT45, "Gage Verification Data Sheet"

II. SNL Form 34, "General Purpose Data Sheet"

QA RECORDS:

I. SNL Form SSSPT45, "Gage Verification Data Sheet"

II. SNL Form 34, "General Purpose Data Sheet"

PROCEDURE:

INTRODUCTION: Sections I. and II. of this procedure guide the user through the HP75000 DAS setup configuration and operation of the checkout program. Refer to SNL Procedure 485 to obtain comparable information for the Fluke Hydra Data Bucket. After reviewing these references, proceed to section III. to initiate cable checkout.

I. HP 75000 DAS SETUP

NOTE: During performance of this procedure, computer keys and text that are required to be selected or typed by the user will be displayed in capital letters and underlined. Significant screen displays that are provided by the program to prompt the user, will be distinguished from procedure text by being listed in **bold** on a separate line.

A. Personal Computer (PC) Setup

CAUTION: These steps must be performed in sequence to ensure a proper link between the HP75000 and the PC.

1. If the DAS (personal computer and/or HP75000) is already operational, proceed to step D.

2. Connect the personal computer (PC) to the HP75000. Turn on the PC and allow it sufficient time to "boot up". The screen will display this message:

   C:\>

3. Type PCPLUS and press ENTER to start the ProComm software and display the PROCOMM PLUS screen and this message:

   PRESS ANY KEY TO ENTER TERMINAL MODE

4. Press ENTER and the screen will display this message:

   PROCOMM PLUS Ready!

B. HP75000 Setup

1. Check the position of the HP75000 mode switch. Ensure that it is in the upper ("System Controller") position.

2. Turn on the HP75000 and allow it sufficient time to "boot up". The HP75000's display will provide this message:

   IBASIC_240:

3. Press the Select Instru key on the HP75000 front panel. The HP75000's display will change to this message:

   Select an instrument.

C. Verify PC to HP75000 Link

1. Ensure that both the PC and the HP75000 are displaying:

   Select an instrument.

2. If the messages agree, proceed to section II. If the messages disagree continue with step D.

D. Reconfiguration of DAS

NOTE: If the DAS is operating in Stand Alone mode or in Lab-Tech mode, contact the SNL DAS Manager or his designee for access.

1. Repeat step I. A. to ensure proper setup of PC.

2. Check the position of the HP75000 mode switch. If the switch is in the "Talk/Listen" position, return it to the "System" position.

3. Reboot the HP75000

a. Press the Select Instru key on the HP75000 front panel. The HP75000's display will change to this message:

Select an instrument.

b. Press the F1 key on the HP75000 front panel. The HP75000's display will change to this message:

SYSTEM_0:
CONFIG? HP-IB RS-232 TIME DATE ->

c. Press the ->/More key on the HP75000 front panel. The HP75000's display will change to this message:

SYSTEM_0:
RESET ->

d. Press the F1 key on the HP75000 front panel. The HP75000's display will change to this message:

IBASIC_240:

e. Press the Select Instru key on the HP75000 front panel. The HP75000's display will change to this message:

Select an instrument.

4. Ensure that both the PC and the HP75000 are displaying:

Select an instrument.

5. If the messages agree, proceed to section II. If the messages disagree contact the SNL DAS Manager or his designee.

II. OPERATION OF THE "CHECKOUT" PROGRAM

A. Loading The Program

1. Press the F4 function key to load IBasic. The screen will display this message on the upper line:

IBASIC_240: Idle

2. Type get "checkout" and press ENTER to load the Checkout program. The screen will display this message:

IBASIC_240: Running

3. When the program is finished loading, the screen will return to the previous message:

IBASIC_240: Idle

4. Type run and press ENTER to start the Checkout program. The screen will display this message:

IBASIC_240: Input?
PROGRAM CHECKOUT START: MM/DD/YYYY HH:MM:SS

ENTER CHANNEL NUMBER (0 TO EXIT)

B. Selecting a Channel

NOTE: If the program locks up at any point during use, press F8, then F1 to reset and return to step A. 4.

1. To determine the channel number (XXX) of a particular gage, refer to the Measurand Definition File (MUX field) or the Cable Spreadsheet.

2. Type XXX and press ENTER to select the desired channel number. The screen will display this additional message:

CHANNEL = XXX
VOLTS or OHMS? (V/O) [V]

?

C. Performing Gage Loop Scans

1. Selecting the type of measurement

NOTE: The message displayed in the previous step indicates that Volts [V] is the default selection. If [O] is displayed instead of [V], then Ohms is the default selection.

a. If the default selection is desired press ENTER and proceed to step 2.

b. If the default measurement type is not desired, then type O for Ohms or V for Volts and press ENTER.

2. The program will access the selected parameter and will display it in loop scan format. As an example if channel 100 was connected to a ~3 Volt signal source and was being scanned, the screen would display:

CHANNEL = 100 VOLTS = 3.124199
CHANNEL = 100 VOLTS = 3.NNNNNN
CHANNEL = 100 VOLTS = 3.NNNNNN
CHANNEL = 100 VOLTS = 3.NNNNNN
CHANNEL = 100 VOLTS = 3.NNNNNN
CHANNEL = 100 VOLTS = 3.NNNNNN
CHANNEL = 100 VOLTS = 3.NNNNNN
CHANNEL = 100 VOLTS = 3.NNNNNN
CHANNEL = 100 VOLTS = 3.NNNNNN

F1 TO STOP

3. Press F1 to stop the loop scan. The screen will display lines of loop scan data and:

ENTER CHANNEL NUMBER (0 TO EXIT)

4. If another channel is desired, return to step B. 1. If loop scans are complete type 0 and press ENTER. The screen will display the last screen of loop scan data, with the last line being the exit message, date and time:

PROGRAM CHECKOUT EXITED: MM/DD/YYYY HH:MM:SS

III. CABLE CHECKOUT

A. Preparation

1. Prepare SNL Form 34 for use as a Cable Checkout data sheet. Complete the upper three header blocks and label the columns as follows:

Column 1	"Gage No."
Column 2	"Pair No."
Column 3	"Channel No."
Column 4	"Polarity Check"
Column 5	"Resistance Check"

2. Refer to Cable spreadsheet and identify the cable that interfaces to the gages requiring hookup. Use this information to complete the "Use:" blank on SNL Form 34

Example: Use: Cable L3/EXT Checkout

3. Refer to Cable spreadsheet to identify the corresponding channel numbers for all gage/cable pairs in this cable.

NOTE: Power supplies do not have channel numbers assigned.

4. On SNL Form 34 record all of the Gage Numbers (including power supplies), the Pair Numbers, and the Channel Numbers for this cable in the designated columns.

   NOTE: Hardwired power supplies will not be disconnected or removed.

5. De-energize and disconnect or remove the power supplies assigned to the gages supplied by this cable.

6. If the cable to be tested is terminated with a connector, attach a cable checkout box to end of cable.

B. Cable Resistance Checks

1. Select the desired channel number.

2. Place the gage/cable pair channel into an Ohms loop scan.

3. Place a short on the end of the corresponding cable pair.

4. Record the measured resistance on SNL Form 34 in the "Resistance Check" column. If the reading indicates an open or short, contact the SNL Cognizant Engineer.

5. Remove the short from the cable pair and stop the loop scan.

6. Repeat steps 1. through 5. for all the gage/cable pairs on the selected cable.

C. Cable Polarity Check

1. Thermocouple Cable

   a. Select the desired channel number.

   b. Place the gage/cable pair channel into a Volts loop scan.

      NOTE: For hardwired systems the installed thermocouple may be used as a simulator.

   c. Connect a Thermocouple Simulator to the selected cable pair.

   d. Monitor the voltage output while applying heat to the Simulator junction.

   e. If the voltage increases during the application of heat, note OK in the "Polarity Check" column of SNL Form 34.

f. Remove the heat from the Simulator and observe the drop in voltage.

g. If the conditions stated in steps e. and f. are not observed, contact the SNL Cognizant Engineer.

h. Stop the loop scan.

i. Repeat steps a. through h. for all the TC/cable pairs on the selected cable.

j. Proceed to step III. E.

2. All Other Cable Types

a. Select the desired channel number.

b. Place the gage/cable pair channel into a Volts loop scan.

NOTE: If testing a cable pair that uses a current viewing resistor, temporarily disconnect the resistor prior to performing step c.

c. Connect a 9 VDC battery to the selected cable pair. Ensure that the + battery pole is connected to the positive cable lead and the - battery pole to the negative cable lead.

d. Record the measured voltage on SNL Form 34 in the "Polarity Check" column. If the reading is negative or outside the bounds of 8.8 to 9.3 VDC, contact the SNL Cognizant Engineer.

e. Disconnect the battery.

f. Stop the loop scan.

g. Repeat steps a. through f. for all the gage/cable pairs on the selected cable.

D. Power Supply Checkout

1. Reconnect or reinstall the power supplies disconnected in step A. 5.

2. Ensure that the first power supply to be tested is de-energized.

3. If the gage jumper is not in the circuit, (and if applicable) jumper the gage excitation leads (power supply) to the gage monitor leads. Ensure that correct polarity is maintained.

4. Select the first of the corresponding channel numbers for this power supply.

5. Place the gage/cable monitor pair channel into a Volts loop scan.

6. Energize the power supply and observe the increase in voltage while slowly adjusting it to the desired excitation voltage.

7. Record the measured voltage on SNL Form 34 in the "Polarity Check" column.

8. Stop the loop scan.

9. If applicable, select the next monitor channel number for this power supply, otherwise proceed to step 13.

10. Place the gage/cable pair channel into a Volts loop scan.

11. Observe the voltage reading and compare to the value recorded in step 7. If it does not agree within +/- 0.01 VDC, contact the SNL Cognizant Engineer.

12. Repeat steps 9. through 11. for the remaining monitors associated with this power supply.

13. If any of the readings are unstable, contact the SNL Cognizant Engineer.

14. De-energize the power supply.

15. Stop the loop scan.

16. Repeat steps 2. through 15. for all the power supplies on the selected cable.

E. Completion

1. If the cable that was tested is terminated with a connector, disconnect the cable checkout box from the end of the cable.

2. If there are additional cables to checkout, return to step A.

3. If complete, exit the Checkout program.

4. If gage hookup to the DAS is desired continue with the next section, otherwise proceed to section VI.

IV. CABLE AND GAGE RESISTANCE MEASUREMENTS

A. Cable Checkout

NOTE: Hardwired power supplies will not be disconnected or removed.

1. De-energize and disconnect or remove the power supply assigned as the excitation source for the gage to be tested.

2. Select the corresponding channel number(s) for this gage. Record these parameters on SNL Form SSSPT45 in "Gage No." and "Channel No." columns.

3. Place the gage output pair into an Ohms loop scan.

4. Place a short on the gage end of the corresponding cable pair.

   a. Gage termination via connector.

      (1) Temporarily disconnect the cable connector(s) from the gage(s).

      (2) Apply a short across the corresponding cable connector pins.

   b. Gage termination via junction box.

      (1) Access the terminal strip inside the junction box.

      (2) Apply a short across the corresponding terminal strip connections.

5. Record the displayed resistance measurement on SNL Form SSSPT45 in the "Cable Resistance" column.

6. Remove the short from the cable pair, observe and confirm the open circuit, and stop the loop scan.

7. Repeat steps 3. through 6. for the gage monitor pair.

B. Gage Checkout

1. If the gage(s) was disconnected in step IV. A. 4. a., reconnect the gage(s) to the cable connector(s).

2. Place the gage output pair into an Ohms loop scan.

3. Record the displayed resistance measurement on SNL Form SSSPT45 in the "Cable + Gage Resistance" column.

4. Stop the loop scan.

5. Repeat steps 2. through 4. for the gage excitation monitor.

V. GAGE AND POWER SUPPLY MONITOR VOLTAGE MEASUREMENTS

A. Power Supply Checkout

1. If applicable, reconnect or reinstall the power supply disconnected in section IV., step A. 1.

2. Place the gage excitation monitor channel into a Volts loop scan.

3. Energize the power supply.

4. While viewing the power supply monitor voltage on screen, adjust the power supply output to the gage calibration excitation voltage (+/- 0.01 VDC).

5. Record the displayed voltage measurement on SNL Form SSSPT45 in the "Output Volts" column.

6. Stop the loop scan.

B. Gage Checkout

1. Voltage Measurement Channels

   a. Place the gage output channel into a Volts loop scan.

   b. Record the displayed voltage measurement on SNL Form SSSPT45 in the "Output Volts" column.

   c. Stop the loop scan.

   d. Calculate the engineering units (EU) value, using the voltage reading from step b. and the gage calibration coefficients (C1 = slope/scale factor; C0 = intercept/offset). Use the Mx + B equation: EU = C1 (output voltage) + C0 and record the result in the "Engineering Units" blank on SNL Form SSSPT45.

   e. If the gage output is also being routed to another channel proceed to the referenced step:

Mx + B Channel	V. B. 2.
Thermocouple Channel	V. B. 3.
No Additional Channel	V. C.

2. Mx + B Measurement Channels

   NOTE: When entering or verifying coefficients in the Fluke Hydra Data Bucket, adjust the scale factor (slope) value to compensate for exponential calibration voltage ranges [the offset (intercept) is not adjusted].

Example 1: If the calibration range = millivolts ($V \times 10^{-3}$), multiply the scale factor by 10^{3} (1000).

Example 2: If the calibration range = volts ($V \times 10^{0}$), multiply the scale factor by 10^{0} (1).

a. Refer to SNL Procedure 485, the gage installation records, the gage calibration records and enter or verify the gage calibration coefficients assigned to the channel under test [coefficient C1 = M (slope or scale factor); coefficient C0 = B (intercept or offset].

b. Place the gage output channel into a Mx + B loop scan.

c. Record the displayed measurement on SNL Form SSSPT45 in the "Engineering Units" column.

d. Stop the loop scan.

e. Verify the Mx + B calculated reading.

1) Compare the calculated EU value from step V. B. 1. d. with the Mx + B reading recorded in step V. B. 2. b.

2) If the values agree within +/- 1 of the least significant figure, all readings are correct and the coefficients are correct. If the values do not agree, repeat this process beginning at step V. B. 1. and contact the SNL Gage Cognizant Engineer.

3. Thermocouple (TC) Measurement Channels

a. Configure the channel function to read voltage.

b. Place the gage output channel into a Volts loop scan.

c. Record the displayed voltage measurement on SNL Form SSSPT45 in the "Output Volts" column.

d. Stop the loop scan.

e. Configure the channel function to read a thermocouple output.

f. Record the displayed measurement on SNL Form SSSPT45 in the "Engineering Units" column.

g. Stop the loop scan.

4. De-energize the power supply and disconnect the cable connector from the gage.

C. If there are additional gages to checkout, repeat sections IV. and V.

D. If gage checkouts are complete, reconnect all gages, energize the power supply, and adjust to the gage calibration excitation voltage (+/- 0.01 VDC).

E. Exit the checkout program.

VI. ACCEPTANCE CRITERIA REVIEW AND COMPLETION OF DATA FORM

A. Cable Checkout

1. Complete SNL Form 34 and route it to the SNL Cable Assistant Project Leader (APL).

2. The SNL Cable APL will technically review the data and comments to ensure that the checkout meets the stated acceptance criteria specified in this procedure.

3. Approval of the data form by the SNL Cable APL indicates that the cables are adequate for their intended use, based on the APL's experience/expertise.

4. The original data form will be routed to the SNL Quality Assurance department.

B. Gage Verification

1. Complete SNL Form SSSPT45 and route it to the SNL Gage Cognizant Engineer.

2. The SNL Gage Cognizant Engineer (CE) will technically review the data and comments to ensure that the installation meets the stated acceptance criteria specified in this procedure.

3. Approval of the data form by the SNL CE indicates that the gages are adequate for their intended use, based on the CE's experience/expertise.

4. The CE will forward the data form to the SNL DAS Assistant Project Leader (APL) for review.

5. Final approval of the data form by the SNL APL indicates that the gages are properly installed into the data acquisition system.

6. The original data form will be routed to the SNL Quality Assurance department.

REVISION SUMMARY

To be completed by procedure's author before final revision is circulated for signatures.

I. Revisions made: Incorporated Redlined Changes and Addendum to increase procedure scope to cover Fluke Hydra Data Bucket Systems.

II. Personnel effected:

(Check appropriate ones)

MOC Craftsman		SNL JOB AREA	
Drilling	____	DAS General	X
Shop	____	DAS B49 Trailer	____
Mechanical	____	DAS Sheds	____
Electrical	____	DAS Equip. Cal. & Inv.	____
Gage	____	Thermocouple	____
Cable/TC	____	Cables	X
U/G DAS	X	Drilling	____
Geotech	____	Gage Installation	X
		Gage Cal. & Removal	____
		Plugging & Sealing	X
		Brine Transport	____
		QA	____
		General	____
		Principal Investigator	____
		Bin Leak Tester	____
		Permeability Testing	____

III. Retraining required:

(Circle One)

Read/(Re-read procedure)

Practical demonstration

Other (explain)

Signature of Procedure's Author Wesley D. Jorgensen Date 10/26/94